

Constructions with Lexical Integrity*

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ABSTRACT

Construction Grammar holds that unpredictable form-meaning combinations are not restricted in size. In particular, there may be phrases that have particular meanings that are not predictable from the words that they contain, but which are nonetheless not purely idiosyncratic. In addressing this observation, some construction grammarians have not only weakened the word/phrase distinction, but also denied the lexicon/grammar distinction. In this paper, we consider the word/phrase and lexicon/grammar distinction in light of Lexical-Functional Grammar and its Lexical Integrity Principle. We show that it is not necessary to remove the word/phrase distinction or the lexicon/grammar distinction to capture constructional effects, although we agree that there are important generalizations involving constructions of all sizes that must be captured at both syntactic and semantic levels. We use LFG's *templates*, bundles of grammatical descriptions, to factor out grammatical information in such a way that it can be

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invoked either by words or by construction-specific phrase structure rules. Phrase structure rules that invoke specific templates are thus the equivalent of phrasal constructions in our approach, but Lexical Integrity and the separation of word and phrase are preserved. Constructional effects are captured by systematically allowing words and phrases to contribute comparable information to LFG's level of functional structure; this is just a generalization of LFG's usual assumption that "morphology competes with syntax" (Bresnan, 2001).

1 WORDS, CONSTRUCTIONS, AND THE LEXICON

The observation that unpredictable form-meaning combinations are not restricted in size forms the basis for Construction Grammar (Fillmore, 1988; Fillmore *et al.*, 1988; Kay and Fillmore, 1999; Goldberg, 1995, 2006; Goldberg and Jackendoff, 2004; Michaelis, 2010; Sag, 2010; Boas and Sag, 2012).¹ A meaning that is associated with a word or a part of a word may also be associated with a phrasal structure in the same language, or in another language. Construction Grammar takes the structure and organization of the collection of listemes/constructions as crucially important, and a central concern is the study of the relations among constructions: this contrasts with Di Sciullo and Williams (1987), who consider the collection of listemes to be unstructured and the study of the relations among listemes uninteresting. Examples such as (1)–(3) involve correspondences between phrasal structures and idiosyncratic meanings; the syntactic frame of the multi-word expression itself, perhaps along with some specifications on what words are permitted, evokes some interpretation.

- (1) The bigger the better. (Fillmore *et al.*, 1988; Culicover and Jackendoff, 1999)
- (2) What's that koala doing sleeping in the corner? (Kay and Fillmore, 1999)
- (3) Smithy drank his way through university. (Jackendoff, 1990; Goldberg, 1995)

¹ See Sag *et al.* (2012) for a historical overview of Construction Grammar and further references. See Sag (2012) for an informal overview of a formal theory of Construction Grammar (Sign-Based Construction Grammar).

Most words in the expressions above are exchangeable for other words, so they seem more flexible than prototypical idioms. Yet their form and associated interpretation must be learned by English speakers, as these constructions do not, it is argued, follow from general compositional principles of English grammar. On the Construction Grammar view, such expressions are not a peripheral part of the grammar which need not be accounted for in grammatical theory; instead, they lie at one end of a continuum of structures relating forms to meanings. Constructions as pairings of form and meaning can be larger or smaller than a word, and can have structure and meaning that is general or predictable to a variable extent. Following on from this view, Construction Grammarians have denied the utility of a strict division between word-internal grammatical regularities and phrasal regularities, or between semantically bleached grammatical structures and structures which contribute specialized or irregular meanings. As a consequence, Construction Grammarians have tended to emphasize commonalities across types of constructions rather than differences, and to de-emphasize differences between word-level and phrase-level constructions.

A distinction between words and multi-word expressions is not fundamental to Construction Grammar, although such a distinction is not necessarily in principle ruled out. In fact, some advocates of Construction Grammar go so far as to claim that the distinction between lexicon and grammar is no longer useful, as illustrated by the following quotes:

[M]orphemes are clear instances of constructions in that they are pairings of meaning and form that are not predictable from anything else. It is a consequence of this definition that the lexicon is not neatly differentiated from the rest of grammar. (Goldberg, 1995, p. 4)

In Construction Grammar, no strict division is assumed between the lexicon and syntax. (Goldberg, 1995, p. 7)

Every theory of language has to take a word to be a complex of phonological, syntactic, and semantic structures; commonly, the store of words is called the *lexicon*. ... *Aspects* [(Chomsky, 1965)] treats the lexicon as a component of language distinct from the rules of grammar. Words are taken to

be the locus of irregularity in language, while rules of grammar encode all the regularities. Words get into sentences by being inserted into syntactic derivations, at the point when syntactic trees are being built and before trees begin to be manipulated and fed to phonology and semantics. ... But while [this view of the lexicon] was altogether plausible in the context of early work in generative grammar, I believe that subsequent developments reveal it as another major mistake that has remained in the background as unquestionable dogma within the mainstream school of thought. (Jackendoff, 2007, p. 53)

It is also telling that the section that contains this last quote is titled “Another Fundamental Mistake: The Lexicon/Grammar Distinction”.

Another perspective on this fundamental issue arises if we ask whether there is any necessary theoretical distinction between words and phrases. Many linguists agree that words and phrases must be distinguished (Anderson, 1992; Aronoff, 1993; Sadler and Spencer, 2000; Stump, 2001; Blevins, 2006), though the word/phrase distinction is denied by some linguists, not just some working in Construction Grammar, but also those working within the Distributed Morphology paradigm (Halle and Marantz, 1993, 1994; Marantz, 1997; Siddiqi, 2009), which otherwise has quite different morphosyntactic assumptions.

We believe that there is a fundamental reason to maintain the distinction between words and phrases that has previously gone unaddressed in the literature. Natural language morphology mainly falls within the class of regular languages (see Beesley and Karttunen 2003 and references therein); even challenging non-concatenative morphological phenomena, such as circumfixation and root-and-pattern morphology, can be characterized by regular means (Beesley and Karttunen, 2000, 2003). There is one exception to this generalization: productive reduplication can be characterized only by a more powerful context-sensitive grammar.² However, morphologists have so far

²Beesley and Karttunen (2000, p. 6) show, however, that, if one can assume that “there are only a finite number of words subject to reduplication (no free compounding)”, even total reduplication, e.g. as in Malay, can be captured by regular means.

not discovered any other phenomenon besides reduplication which requires going beyond regular languages: words do not contain deeply nested dependencies or long-distance dependencies, for example. It seems, then, that natural language morphology falls within the regular languages, with one exception: reduplication.

Natural language syntax is formally very different: it is pervaded by dependencies that require at least context-free power to describe. Partee *et al.* (1993, pp. 480ff.) provide a proof that English is not a finite-state language, using nested dependencies and the Pumping Lemma. The question of whether natural language syntax falls outside the class of context-free languages has been more difficult to answer, and early arguments for the inadequacy of context-free grammars for natural language syntax were shown to be flawed by Pullum and Gazdar (1982). Shieber (1985) provided a definitive proof that natural language syntax falls in the class of mildly context-sensitive languages (Joshi *et al.*, 1991; Vijay-Shanker and Weir, 1994), on the basis of data from Swiss German cross-serial dependencies. In fact, however, cross-serial dependencies seem to be the only phenomenon requiring more than context-free power for natural language syntax, and it may be that languages without cross-serial dependencies can be satisfactorily characterized in context-free terms.

Whether natural language syntax is mainly context-free or fully context-sensitive, the substantial formal differences between morphology and syntax remain entirely unexplained if the full computational power of the syntactic system underlies morphology. If morphology has the full power of syntax, why are there no clear morphological equivalents of unbounded or nested dependencies? It is of course possible that morphology does have the full expressive power of syntax, but we simply have not yet come across languages with unbounded morphological dependencies. However, this would be surprising, given that unbounded dependencies are syntactically prevalent across the world's languages. Similarly, why do we fail to find reduplication in the syntax, if there is no important formal distinction between morphology and syntax? These questions do not arise if we maintain a theoretical distinction between words and phrases.

In this paper, we will show that it is not necessary to remove the word/phrase distinction or the lexicon/grammar distinction to capture constructional effects, although we agree that there are important

generalizations involving constructions of all sizes that must be captured at both grammatical and semantic levels. In keeping with much other work in Lexical Functional Grammar (see particularly Bresnan, 2001, Chapter 6), we believe that the proper grammatical level for characterizing similarities across constructions is a level like LFG's *functional structure* (f-structure), which represents abstract syntactic relations such as subject, object, and adjunct, as well as syntactic features such as person, number, gender, case, tense, and aspect. In contrast, the *constituent structure* (c-structure) tree encodes word order, phrasal dominance, and grouping; it is the level at which the difference between words and phrases is represented, in keeping with the *Lexical Integrity Principle*. As Bresnan (2001, p. 93) observes, "... LFG's lexical integrity principle implies that while morphemic words and syntactic phrases are different types of forms of expression in c-structure, they may carry the same types of information in f-structure. In other words, these different forms of expression – words and phrases – may be functionally equivalent (in terms of f-structure content)."

An early statement of Lexical Integrity was provided by Simpson (1983, p. 74):

- (4) *Lexical Integrity* (Simpson, 1983, p. 74)

No constituent structure rule may order any element into or out of lexical categories such as N, A, V. That is, constituent structure rules are blind to the internal structure of lexical categories.

Subsequent work within LFG has adopted Lexical Integrity as a fundamental principle differentiating word-internal structure from phrasal syntax, as in (5), and establishing words as indivisible, undecomposable units at c-structure as in (6):

- (5) *Lexical Integrity* (Bresnan and Mchombo, 1995, p. 181)

Words are built out of different structural elements and by different principles of composition than syntactic phrases.

- (6) *Lexical Integrity* (Bresnan, 2001, p. 93)

Morphologically complete words are leaves of the c[onstituent]-structure tree and each leaf corresponds to one and only one c[onstituent]-structure node.

In a series of papers, Booij (2005a,b, 2009) provides substantial evidence for the Lexical Integrity Principle from a Construction Grammar

viewpoint. His observations are an excellent fit with the LFG view of Lexical Integrity, which assumes that syntactic rules have access to certain (f-structural) aspects of word-internal structure, but not to other (c-structural) aspects.

The c-structure/f-structure distinction is crucial to the LFG-theoretic understanding of the *Strong Lexicalist Hypothesis*, which is essentially what Lexical Integrity captures. The Strong Lexicalist Hypothesis states that syntactic rules of phrase formation cannot access any parts of words. This is a generalization of the *Weak Lexicalist Hypothesis*, which states that syntactic rules cannot access derivational morphology, but allows access to inflectional morphology. Marantz (1997) has argued that lexicalism is untenable based on the view that morphology can make complex syntactic contributions; this is the foundational doctrine of Distributed Morphology. However, although Marantz (1997) has often been taken as arguing against lexicalism *tout court*, his arguments actually depend on his particular conception of syntax, which does not distinguish constituent structure from functional structure.

Lexical Integrity as a principle of c-structure does not disallow words from making complex contributions at functional structure; this means that it is possible for individual, morphologically complex words to express the same information as multi-word expressions. For example, the future tense can be expressed with verbal morphology as in the French example in (7), or with a future auxiliary as in the English example in (8).

- (7) Il arrivera.
he arrive.FUTURE
'He will arrive.'

- (8) He will arrive.

In (7), the future tense is realized directly on the main verb. In contrast, the future is expressed with the morphologically independent auxiliary *will* in (8); see Ackerman and Webelhuth (1998) and Ackerman and Stump (2004) for more discussion of examples of this type.

To take another example, the Swedish singular indefinite marker is a determiner, as in English, realized as *en* or *ett* depending on the gender. However, the Swedish definite marker is a morphologically

bound suffix on the noun. Example (9) shows the periphrastic indefinite + noun combination, while (10) shows the same noun with a definite suffix:

- (9) En väg kan vara mycket lång.
 a road can be very long
 ‘A road can be very long.’
- (10) Vägen hem var mycket lång.
 road.the home was very long
 ‘The road home was very long.’

The periphrastic expressions *will arrive*, *en väg* and *a/the road* are comparable to the synthetic *arrivera* and *vägen*. The periphrastic and synthetic forms alike contain information that is syntactically relevant.

The dual nature of syntactic structure in Lexical Functional Grammar (LFG: Bresnan 2001; Dalrymple 2001; Falk 2001) captures both the commonalities and the differences between words and phrases, as argued at length by Simpson (1983), Mohanan (1994, 1995), Bresnan and Mchombo (1995), Matsumoto (1996), Bresnan (2001), and many others. Constituent structure represents surface word order and phrasal grouping; in accordance with Lexical Integrity, morphologically bound information about tense and definiteness is ‘invisible’ at c-structure, in the sense that the information is not hosted by separate c-structure nodes. At functional structure, words and phrases can make similar or identical syntactic contributions, accounting for the similarities between words and phrases at this more abstract syntactic level: as Bresnan (1998) puts it, morphology competes with syntax in cases like (7)–(10), specifying similar grammatical structure by different morphological means. LFG’s definition of Lexical Integrity entails that individual morphemes may contribute to functional structure, while the smallest unit visible at constituent structure is the word.

A comparison of English *the road* and Swedish *vägen* shows that morphology can contribute information directly to the f-structure without violating Lexical Integrity at c-structure. Lexical entries for *the*, *road*, and *vägen* are given in (11)–(13):

- (11) the D (↑ DEFINITE) = +

- (12) road N (\uparrow PRED) = 'road'
 (\uparrow NUMBER) = SG
 (\uparrow PERSON) = 3
- (13) vägen N (\uparrow PRED) = 'road'
 (\uparrow NUMBER) = SG
 (\uparrow PERSON) = 3
 (\uparrow DEFINITE) = +
 (\uparrow GENDER) = COMMON

C-structures and f-structures for *the road* and *vägen* are given in (14):

- (14)
- | | |
|--|--|
| $ \begin{array}{c} \text{NP} \\ \\ \text{N}' \\ \\ \text{N} \\ \\ \text{vägen} \end{array} $ | $ \left[\begin{array}{ll} \text{PRED} & \text{'road'} \\ \text{DEFINITE} & + \\ \text{NUMBER} & \text{SG} \\ \text{PERSON} & 3 \\ \text{GENDER} & \text{COMMON} \end{array} \right] $ |
|--|--|

- (15)
- | | |
|---|--|
| $ \begin{array}{c} \text{DP} \\ \\ \text{D}' \\ \swarrow \quad \searrow \\ \text{D} \quad \text{NP} \\ \quad \\ \text{the} \quad \text{N}' \\ \quad \quad \\ \quad \quad \text{N} \\ \quad \quad \\ \quad \quad \text{road} \end{array} $ | $ \left[\begin{array}{ll} \text{PRED} & \text{'road'} \\ \text{DEFINITE} & + \\ \text{NUMBER} & \text{SG} \\ \text{PERSON} & 3 \end{array} \right] $ |
|---|--|

Despite the very different c-structures for *the road* and *vägen*, the f-structures are almost identical, the only difference being that English nouns do not bear gender. In LFG, syntactically relevant information can be contributed to the f-structure by bound morphology, even though the internal complexity of words is invisible at c-structure. Lexical Integrity is therefore maintained at c-structure.

Multi-word constructions, handled straightforwardly in Construction Grammar, pose a direct problem for a framework like LFG that adopts the Strong Lexicalist Hypothesis. Most work referring to Lexical Integrity in LFG has focused on the internal structure of words. How-

ever, the principle is more general than that: Lexical Integrity dictates that there is a one-to-one mapping between fully inflected words and c-structure nodes. In other words, units smaller than a word cannot be inserted into c-structure and units bigger than words cannot be inserted into c-structure. Each word is independent and corresponds to a single c-structure node. This is problematic when a particular combination of words gives rise to a meaning non-compositionally (or perhaps semi-compositionally), as has been argued to be the case for expressions such as those in (1)–(3).

This paper proposes that the key to capturing constructional effects in LFG is the observation, outlined above, that words and phrases can make identical contributions to f-structure. Given the Glue Semantics approach to compositional semantics (Dalrymple, 1999, 2001; Asudeh, 2012), which allows terms for semantic composition to be specified based on f-structures, this equally means that words and phrases can make identical semantic contributions. We provide a means of expressing commonalities in functional structure and semantics across linguistic units of various sizes through the means of LFG’s *templates* (Dalrymple *et al.*, 2004; Asudeh, 2012), bundles of grammatical descriptions, which can be associated with parts of words, with words, or with phrases. Templates can be defined in terms of other templates, thus allowing us to express similarities and differences between constructions, whether they are expressed by a single word or a phrase. In this way, we account for the similarities between words and phrases which have been a focus of work within Construction Grammar, but within a framework which also incorporates the differences between words/phrases and lexicon/grammar as a fundamental architectural principle. We believe that our proposals are valid no matter what theory of morphology is adopted, and no matter whether the term “lexicon” refers to a list of words, a list of morphemes, or a list of all unpredictable form-meaning pairs whatever their size.

The paper is structured as follows. In Section 2, we present three similar constructions in English, Swedish, and Dutch and show that the constructions are expressed differently in the different languages. In Section 3, we present templates and show how they can be used to express generalizations. In Section 4, we present our formal analysis in terms of LFG with Glue Semantics. In Section 5, we briefly consider a further generalization of the theory in terms of linking theory,

which concerns the instantiation of grammatical functions based on argument structure. Section 6 is the conclusion. The paper ends with a set of formal appendices, which includes complete Glue proofs for three examples.

2 CONSTRUCTIONS EXPRESSED IN WORDS AND PHRASES

We first present our view of constructions in LFG. As an illustration of our view, we examine variants of the traversal construction in English, Swedish, and Dutch, showing that different properties of the construction – the phrasal configuration, some combination of words in the construction, or both – are responsible for its meaning. Section 2.1 discusses the English *way*-construction, which is signalled by the presence of the word *way*. Section 2.2 discusses the Swedish counterpart of this construction, the Directed Motion Construction, which is signalled not by a particular word, but by a special phrasal configuration. Finally, Section 2.3 presents two Dutch constructions, the *weg*-construction and the Transition to Location Construction; the *weg*-construction is similar to its English counterpart, in that the construction is signalled by the presence of the word *weg*. The Dutch Transition to Location Construction is different from both English and Swedish, in that there is no special word or phrasal configuration to signal the construction. Each of these patterns involves specification of the constraints associated with the construction in a different way: associated with a word other than the head predicate (English *way* or Dutch *weg*); associated with a special phrase structure rule (the Swedish Directed Motion Construction); or associated with the main, head predicate of the construction (the Dutch Transition to Location Construction).

2.1 *Signalled by a non-head word*

It has been argued that the English *way*-construction in (16) deserves a constructional analysis rather than a compositional one, since the construction implies directed motion even though none of the individual words in *way*-examples necessarily denote motion (Jackendoff,

1992, 1990; Goldberg, 1995).³ Our analysis associates constraints on the form and meaning of the construction with the word *way*.

The analysis must capture several generalizations about this construction. The action denoted by the verb *elbow* does not normally involve traversal, though in example (16) this meaning is present.

(16) Sarah elbowed her way through the crowd.

In fact, for most English speakers the English *way*-construction has two closely related meanings, one involving means and one involving manner (Jackendoff 1990, p. 215, Goldberg 1995, pp. 202–212), though Goldberg (1995, pp. 202–203) points out that the manner interpretation is not available for all speakers. Examples (17) and (18) both involve an event denoted by the main verb (whistling or elbowing) and its relation to a second event of traversal of a path. The verb *elbowed* in example (17) specifies the means by which Sarah managed to traverse the crowd: the traversal was made possible by the elbowing action. For those who allow the manner interpretation, the verb *whistled* in example (18) specifies the manner in which the traversal of the room took place: Sarah whistled while crossing the room.

(17) Means: Sarah elbowed her way through the crowd. (traversed the crowd by means of elbowing)

(18) Manner: Sarah whistled her way across the room. (traversed the room while whistling)

Our analysis allows us to specify what these meanings have in common and how they differ; it also allows the statement of cross-linguistic similarities and differences in similar constructions in other languages.

Jackendoff (1990, p. 216) and others have claimed that the possessor in the English *way*-construction must be coreferential with the subject, and indeed, in an overwhelming number of cases, this generalization holds. However, we have found examples which counterexample this claim:⁴

³Marantz (1992) informally sketches an alternative view of the *way*-construction, which attempts to derive properties of the construction from facts about direct complementation and secondary predication.

⁴A reviewer suggests that the possessor must nevertheless somehow be ‘linked’ to the subject, even if coreference is too strong a constraint. If so, the link need not be narrowly syntactic, as already witnessed by the total lack of a

- (19) He had bought his son's way into an exclusive military academy normally reserved for the gentry and had outfitted him in style.
www.samizdat.com/hero7.html (retrieved May 27, 2013)
- (20) As ambassador, Chesterfield negotiated Britain's way into the Treaty of Vienna in 1731.
www.aim25.ac.uk/cgi-bin/frames/fulldesc?coll_id=2117{&}\inst_id=86
(retrieved May 27, 2013)

Furthermore, the noun *way* in the *way*-construction can be modified (Jackendoff 1990, p. 217, Goldberg 1995, p. 206):

- (21) In these last twenty years Richard Strauss has flamed his meteoric way into our ken – and out of it. (Buchanan, 1918)

An analysis of the construction must be able to derive a meaning for these examples as well; our analysis does.

2.2 *Signalled by a special phrasal configuration*

Toivonen (2002) discusses the Swedish Directed Motion Construction (DMC). The DMC, which is exemplified in (22), consists of a subject, a verb, a weak reflexive (coindexed with the subject), and a directional PP.

- (22) Sarah armbågade sig genom mängden.
S. elbowed SELF through crowd.DEF
~'Sarah elbowed her way through the crowd.'

The Swedish DMC is very similar in meaning and use to the English *way*-construction, but the DMC does not include any word such as

pronoun in (20) and as further emphasized by the fact that the *way*-phrase may simply be an indefinite:

- (i) Daimler bought a way into the Chinese market and then removed Chrysler from it.
www.thetruthaboutcars.com/2013/04/jeep-eyeing-chinese-cherokee-production/ (retrieved May 28, 2013)

Therefore, the link between the subject and the possessor is at best something akin to 'bridging' (Haviland and Clark, 1974), although the latter term is typically associated with definites, not indefinites. Bridging is normally viewed as a pragmatic inference. We return to this issue in footnote 16 below, after the formal analysis has been introduced.

way to flag the construction. Instead, the construction is distinguished by the strict requirement for the presence of certain constituents, restrictions on the individual constituents, and perhaps most interestingly, by a word order quirk at odds with the rest of Swedish grammar (Toivonen, 2002). This word order quirk is only seen in DMC expressions that contain a verbal particle. Consider (23a–b):

- (23) a. Jonas knuffade sig in i mängden.
 J. pushed SELF in inside crowd.DEF
 ‘Jonas pushed his way into the crowd.’
 b. Jonas knuffade in dig i mängden.
 J. pushed in you inside crowd.DEF
 ‘Jonas pushed you into the crowd.’

Verbal particles in Swedish (such as *in*) are normally adjoined to the verb, and must precede the direct object, as in (23b) (Toivonen, 2003). However, in the DMC, the particle may not adjoin to the verb; instead, it is a part of the PP, *in i mängden*, and follows the reflexive, for example *sig* in (23a).

Toivonen (2002) considers two distinct analyses of the DMC. One proposed analysis is constructional, in the sense that the DMC meaning is associated directly with a syntactic frame; we adopt an analysis of this sort, as we discuss below. The other analysis is purely lexical: the DMC verb is related to another verb via a lexical redundancy rule. The DMC verb carries very detailed specifications about what types of arguments it must take. Two facts disfavour the second analysis, which ties the DMC to the verb: first, DMC verbs cannot participate in any kind of derivational morphology. They cannot be turned into nouns or adjectives, for example. The DMC verbs can also not be passivized. Second, the most striking distinguishing feature of the DMC is the peculiar word order constraint mentioned above. Prepositional particles cannot appear in the normal, pre-object particle position in the DMC. This is what distinguishes the DMC from resultatives, for example. For these reasons, we prefer an analysis which connects the DMC meaning with a specific phrase structural configuration.

2.3 *Signalled by the head*

Van Egmond (2006, 2009) shows that Dutch has two constructions that indicate traversal of a path. One construction contains the word

weg ‘way’ (24), and the other does not (25).

(24) Wij worstelen ons een weg door de menigte.
 we wrestle ourselves a way through the crowd
 ‘We are wrestling our way through the crowd.’

(25) Janneke bluft zich uit de benarde situatie.
 J. bluffs SELF out the awkward situation
 ~‘Janneke bluffs her way out of the awkward situation.’

The *weg*-construction exemplified in (24) is also discussed in Verhagen (2003).

Although the two Dutch constructions are similar in meaning, van Egmond (2006, 2009) shows that they nevertheless have distinct interpretations. She calls the type with *weg* (24) the ‘*weg*-construction’, and the type without *weg* (25) the ‘Transition to Location Construction’ (TLC). The *weg*-construction describes an incremental traversal of a path by means of (or while) performing the activity denoted by the verb. The traversal and the activity denoted by the verb are coidentified: the construction describes a simple event. The TLC, on the other hand, describes a transition to a stative location by means of performing the activity denoted by the verb, without necessarily traversing a path. The traversal and the activity denoted by the verb are two subevents that are not necessarily coextensive. For example, in (25), the bluffing event can take place at a point in time preceding the event in which the subject gets out of the awkward situation.

We are here interested in the TLC, as it provides an interesting contrast to the English and Swedish constructions introduced above. Unlike the English *way*-construction, the TLC does not contain a specific word (such as *way*) that ‘flags’ the construction, and unlike the Swedish DMC, the Dutch TLC does not display special syntax: the word order follows the rules of regular Dutch syntax.⁵ We propose that the TLC information is associated with the verb. No matter which verb is included in the construction, the TLC requires exactly three arguments: a subject, a reflexive direct object and a postpositional oblique.

⁵ The PP in the Dutch examples is a prepositional phrase, not a postpositional phrase. Directional PPs normally contain postpositions in Dutch, while stative locations are prepositional PPs. The fact that the TLC contains postpositions and not prepositions follows from van Egmond’s (2006; 2009, pp. 99–101) analysis of the TLC as an expression of transition to a stative location.

The TLC changes the basic argument requirements of the verb, and is in this way comparable to passives, causatives and applicatives, all of which also have relation-changing characteristics. Relation-changing processes are standardly treated in LFG as alternative ways of mapping thematic roles to syntactic roles.

2.4

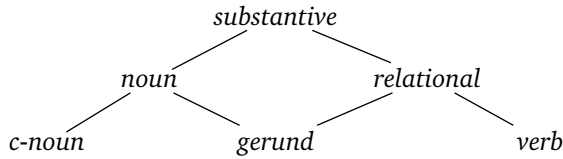
Summary

These expressions from Swedish, English and Dutch have in common a core part of their meanings and also the fact that their meanings are not straightforwardly predictable from the meanings that their parts have in other contexts. Each of them has been noted to be problematic for Lexical Integrity. Below, we present analyses of these constructions that capture the relevant data while preserving Lexical Integrity. The Swedish DMC, the English *way*-construction, and the Dutch *weg*-construction and TLC have distinct syntactic realizations. However, as has been argued in detail by van Egmond (2006, 2009), Toivonen (2002) and Verhagen (2003), there are nevertheless strong reasons for treating them as distinct realizations of the same ‘construction’. The basic similarity lies in their meaning, as is evident from the fact that the expressions translate into each other across the languages. The expressions entail *traversal*, even though this sense is not necessarily contributed by the verb. The verb does not need to be a motion verb. Our task is to capture the similarities between the constructions, while at the same time modelling their differences. The constructions crucially differ in which formal element carries the traversal meaning. We assume that the traversal meaning is signalled by the word *way* in English, as this word is necessarily present. The Swedish DMC does not contain a specific word signalling the construction; all words in the Swedish DMC are exchangeable, since even the reflexive changes to agree with its antecedent. Instead, the construction is flagged by its word order. We therefore assume that the information that is specific for the traversal reading is tied to a phrase structure rule. Finally, the Dutch TLC is not associated with a specific word or peculiar word order. We therefore make the assumption that the clausal head, the verb, is the locus of the relevant information.

and Sign-Based Construction Grammar (SBCG; Michaelis, 2010; Sag, 2010; Boas and Sag, 2012). However, there are some noteworthy differences between templates and types. First, type hierarchies represent relations between structures, whereas template hierarchies represent relations between descriptions of structures. This means that templates do not appear in the actual structures of the theory, but only in descriptions that the structures must satisfy. This contrasts with types in HPSG, where each structure (a directed acyclic graph) is associated with a type.

Second, type hierarchies in HPSG and SBCG represent inheritance in an *and/or* semilattice. The daughters of a type represent disjoint subtypes (*or*). Multiple mothers for a type represent conjoined super-types (*and*). For example, consider the following type hierarchy from Malouf (1998):

(26)



The type *substantive* is a subtype of the root type *head* (not shown here). Its two daughters, *noun* and *relational*, disjointly partition the super-type. Each of the types *noun* and *relational* in turn has two daughters that disjointly partition the type. However, the type *gerund* is common to both and constitutes a conjunction of the supertypes: a *gerund* object is both a *noun* object and a *relational* object.

Template hierarchies do not represent inheritance, but rather inclusion. If a template A dominates a template B, then the description that A labels appears in the description that B labels. The semantics of template invocation, denoted by the prefix @ in a description, is just substitution. For example, given the 3SG template in (27) below, the lexical entries in (28a) and (28b) are strictly equivalent.

(27) 3SG := (↑ SUBJ PERS) = 3

(↑ SUBJ NUM) = SG

(28) a. *laughs* (↑ PRED) = 'laugh<SUBJ>'

(↑ SUBJ PERS) = 3

(↑ SUBJ NUM) = SG

b. *laughs* (↑ PRED) = 'laugh<SUBJ>'

@3SG

It is clear from this example that a template is nothing more than an abbreviation for an LFG description. Throughout this paper, we use the term ‘hierarchy’ in reference to templates to mean ‘inclusion hierarchy’, not ‘inheritance hierarchy’.

Descriptions in LFG support the boolean operations of conjunction, disjunction and negation. Templates therefore also support these operations. For example, the 3SG template can be negated in a lexical entry:

- (29) *laugh* (\uparrow PRED) = ‘*laugh*(SUBJ)’
 \neg @3SG

The lexical entries for *laughs* and *laugh* would thus both be daughters of the template 3SG in a template hierarchy, because both entries include the template, even if one negates it and the other does not:

- (30)
- $$\begin{array}{c} 3SG \\ \swarrow \quad \searrow \\ laugh \quad laughs \end{array}$$

This emphasizes the difference between a hierarchy that represents inheritance, as in HPSG or SBCG type hierarchies, versus a network that represents inclusion, as in LFG template hierarchies. It would not make sense for both *laugh* and *laughs* to *inherit* from a 3SG type object, but both words can nevertheless *include* the description (with or without negation) that is labelled by the 3SG template.

Templates can also be parametrized, where the parameters are stated as arguments to the template. For example, the template in (31) could be used in the lexical entry for any intransitive verb, such that the entry for *laughs* could be rewritten as in (32).

- (31) INTRANS(P) := (\uparrow PRED) = ‘P(SUBJ)’

- (32) *laughs* @INTRANS(*laugh*)
 @3SG

The lexical entry for *laughs* in (32) is still strictly equivalent to the one in (28b), but the templates bring to the fore the generalization that the only idiosyncratic information is what is contributed by the verb root. For example, the entry for *yawns* would differ only in the argument to the parametrized INTRANS template (‘yawn’ instead of ‘laugh’).

The question potentially arises of where templatic information is stored in an LFG grammar.⁶ Since templates are abbreviations for

⁶We thank one of our anonymous reviewers for raising this point.

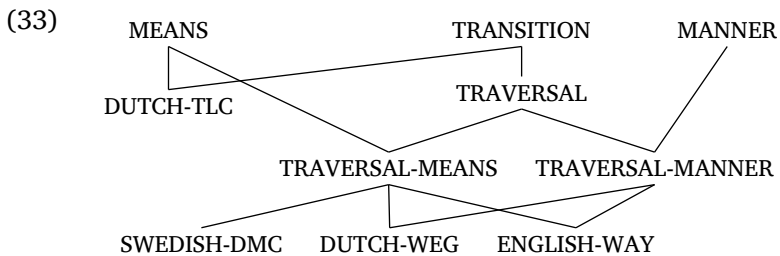
functional descriptions, they need to be accessible to any component of the grammar that makes use of f-descriptions, in particular the lexicon and c-structure rules. In the Xerox Linguistic Environment (Crouch *et al.*, 2012), the standard grammar development platform for LFG, each grammar can have a section that defines templates; this component is loaded with the lexicon and rule components.

Lastly, as we will see presently, template hierarchies need not have a single root: there is no need for a most general template whose description is included in all of the other templates in the network. Templates can include references to other templates, or they can stand alone, as we will see in our definition of the Transition Template Hierarchy.

3.2 The Transition Template Hierarchy

We propose a single theory of constructions that uses existing LFG mechanisms to capture commonalities involving the traversal/result construction in English, Swedish, and Dutch. Our theory preserves the intuition that similar constructional specifications can be associated with different components of the construction. The English *way*-construction is driven by lexical specifications for *way*, together with general phrase structural facts about English. Similarly, the Dutch *weg*-construction is driven by lexical specifications for *weg*. The Swedish DMC is driven by a specific phrase-structural configuration. The Dutch TLC is associated with specifications on the verbal predicate.

The template hierarchy we assume is represented in (33):⁷



The template TRANSITION contains material that is common to the Swedish, Dutch, and English constructions; it encodes information

⁷ Note that this hierarchy is not directly represented as a hierarchy in a grammar, but rather is a representation of the inclusion relations between the relevant templates.

about agency and causation. MEANS and MANNER are two other general templates that specify information about the means or manner of the event. The TRAVERSAL template is defined in terms of the more general TRANSITION template, as represented by the line connecting them, which means that TRAVERSAL includes all of the information associated with the TRANSITION template while also contributing some information specific to TRAVERSAL. TRAVERSAL in turn appears as a part of the definition of both the TRAVERSAL-MEANS template and the TRAVERSAL-MANNER template.

The templates TRAVERSAL-MEANS and TRAVERSAL-MANNER provide different ways of adding information to the TRAVERSAL template, supplying the information that the main verb denotes either the means or the manner in which the path traversal is achieved. The Swedish DMC has the means interpretation (Toivonen, 2002, p. 318), and so we treat it as associated with the TRAVERSAL-MEANS template; the manner interpretation may be available dialectally, but we do not treat this variation here. The templates SWEDISH-DMC, DUTCH-WEG, and ENGLISH-WAY contribute additional language-specific information to these templates, as we will see. Finally, the DUTCH-TLC is another language-specific template which draws together information from MEANS and TRANSITION.

In keeping with LFG's focus on typological generalizations, this templatic approach sheds light on differences and similarities in constructional effects across languages. Information that is shared across constructions in a language can be stated in non-terminal nodes of the template hierarchy and is inherited by specific constructional templates. Similarly, the fact that grammatical information may be shared by constructions in different languages is captured by calls in language-specific constructional templates to the same more general templates in the hierarchy. This approach to grammatical variation is of long standing in the HPSG and now Sign-Based Construction Grammar traditions; see Pollard and Sag (1994, pp. 57–59) and discussion in Sag *et al.* (2012).

For example, the English *way*-construction (on one interpretation), the Swedish Directed Motion Construction, and the Dutch *weg*-construction all share a meaning component that concerns means of traversal of a path and therefore all call the TRAVERSAL-MEANS template in our hierarchy. The template hierarchy thus illustrates

a typological space of possibilities. We leave it an open question whether these possibilities are made available to the language learner in Universal Grammar or whether the hierarchy is simply a convenient way to describe and classify the relevant constructions that can be observed cross-linguistically. For clarity of exposition, we have chosen to label the terminal templates in the hierarchy with language-specific names, such as ‘SWEDISH-DMC’, but the constellation of template calls and additional information that is realized in this template may of course also be instantiated in this exact form in other languages. Therefore, more accurate but less user-friendly names for the terminal templates would be names like ‘TRAVERSAL-MEANS-PHRASAL’, ‘TRAVERSAL-MEANS-NON-HEAD-MARKED’, ‘TRAVERSAL-MEANS-HEAD-MARKED’, and so forth.

4 FORMAL ANALYSIS

4.1 *Phrase structurally flagged constructions*

4.1.1 The phrase structure rule

Turning first to the Swedish DMC, we propose that this construction is most elegantly analyzed with the following construction-specific phrase structure rule, which makes crucial use of a call to the template SWEDISH-DMC:⁸

$$\begin{array}{llll}
 (34) & V' & \rightarrow & (V^0) \qquad \qquad \qquad NP \qquad \qquad \qquad PP \\
 & & & \uparrow = \downarrow \qquad \qquad \qquad (\uparrow \text{ OBJ}) = \downarrow \qquad \qquad \qquad (\uparrow \text{ OBL}) = \downarrow \\
 & & & (\downarrow \text{ PRONTYPE}) = \\
 & & & \text{SIMPLEX-REFLEXIVE} \\
 & & & @\text{SWEDISH-DMC}(\uparrow \text{ PRED FN})
 \end{array}$$

The template call appears on the NP node. This is a partially arbitrary

⁸In some of the literature on templates (Dalrymple *et al.*, 2004), distinct arguments to parametrized templates are separated by spaces, but we follow the convention of Asudeh (2012) of separating arguments to templates explicitly using commas. Spaces, in our notation, do not indicate distinct arguments, but rather serve their standard role in LFG feature specifications. Thus, in this c-structure rule, the template takes a single argument (not three): the f-structure described by $\uparrow \text{ PRED FN}$.

decision; the call could instead appear on another node. We chose the NP, as we see the reflexive as a signal of the construction. Note, however, that the reflexive changes according to the person and number of the subject: it is not a fixed lexical marker of the construction, which makes it different from *way/weg*. By convention, template calls are marked by the at sign '@'. The SWEDISH-DMC template takes a single argument, the value of the PRED FN of the V'; we provide more information about this template in Section 4.1.2.

Notice that FN is not itself a semantic form, but rather part of a semantic form; the attribute FN and argument designators such as ARG1 allow reference to the components of a semantic form (Crouch *et al.*, 2012) according to the following pattern:⁹

(35) [PRED 'FN{ARG1,ARG2,...}NONARG1,NONARG2,...']

The specifications in (36a,b) are thus equivalent:

- (36) a. (f PRED) = 'elbow((\uparrow SUBJ),(\uparrow OBJ))'
 b. (f PRED FN) = elbow
 (f PRED ARG1) = (\uparrow SUBJ)
 (f PRED ARG2) = (\uparrow OBJ)

Use of the attribute FN thus allows reference to the predicate name in PRED features, setting subcategorization aside. The implications of this are further discussed in Section 4.2 below.

We observe four important properties of our treatment of the SWEDISH-DMC. First, associating the template for this construction with a special phrase structure rule reflects the fact that only this particular configuration has the special meaning associated with the DMC.

Second, the NP and PP daughters of V' in (34) are obligatory. Our theory assumes that optionality must be explicitly marked in phrase structure rules, as in computational LFG treatments (e.g. Crouch *et al.* 2012) and in contrast to theoretical positions that allow generalized optionality (e.g. Bresnan 2001). The V⁰ node is optional, since the verb need not appear there: the Swedish finite verb appears in I rather than V.

⁹The arguments of the semantic form are separated into thematic and non-thematic arguments, indicated by ARG_n and NONARG_n respectively.

Third, we must explicitly state the fact that the NP is a simplex reflexive, such as *sig*, and not just any kind of NP or even a complex reflexive (e.g. *sig själv*).¹⁰

Fourth, the construction requires an OBL(IQUE) phrase. Since the OBL must be realized as a post-object PP, it cannot also be realized as a pre-object particle. Post-object particles are projecting, intransitive prepositions (Jackendoff, 1973; Toivonen, 2003). The OBL must be directional, which we capture by referring to a PATH feature in semantic structure, as in (42) below.

4.1.2 The SWEDISH-DMC template

Semantically, the Swedish DMC and the English *way*-construction involve an event characterized by the main verb in the construction and a second event involving traversal of a path. The basic template TRANSITION is defined as follows:

$$(37) \quad \text{TRANSITION} := \\ \lambda R \lambda x \lambda e \lambda e'. R(e) \wedge \text{agent}(e) = x \wedge \text{cause}(e') = x : \\ (\uparrow_{\sigma} \text{REL}) \multimap (\uparrow \text{SUBJ})_{\sigma} \multimap (\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}$$

Templates encoding syntactic information and expressing syntactic generalizations are defined as sets of functional equations, as described by Dalrymple *et al.* (2004). However, since our concern is the syntax–semantics interface and meaning differences among constructions, we define this template with a *meaning constructor* (Dalrymple, 1999, 2001; Asudeh, 2004, 2012), which provides part of the common meaning for the traversal/result construction in English, Swedish, and Dutch.¹¹ This meaning constructor requires:

- a REL meaning R specifying the nature of the event e , which is provided by the verb in the construction; for *Bill elbowed his way through the crowd*, e is required to be an event of elbowing, and so R is the predicate *elbow*;
- a meaning x for the subject of the main verb, which is interpreted as the agent of e and the causer of the transition event e' ;

¹⁰ This information could be moved into the SWEDISH-DMC template itself. We leave it on the phrase structure rule simply to highlight it.

¹¹ The subscripted σ 's in meaning constructors indicate mappings to semantic structure, a level in LFG's grammatical architecture (Dalrymple, 2001; Asudeh, 2012).

- two event variables e and e' , associated with the semantic attributes, EVENT1 and EVENT2, representing the event denoted by the verb and the transition event.

This basic meaning is augmented by other meaning constructors in the template hierarchy. Our characterization of the subject of the main event as an agent of the event e and a causer of the transition event e' follows Goldberg (1995, pp. 212–213), who claims that the motion in the way-construction must be self-propelled. However, Jackendoff (1990, p. 216) suggests that although the means interpretation is necessarily tied to deliberate action, the manner interpretation is also compatible with action that is not deliberately performed. Examples such as (38), which has a manner and not a means interpretation, are better characterized by Jackendoff; in this example, e is an event of bleeding, which is not associated with an agent:

(38) Baxter's wife said her son bled his way into the ambulance painlessly.

newvoices.org/2005/03/08/0089/ (retrieved May 28, 2013)

To account for these examples, it may be better to refer to the highest thematic argument of the main event e rather than explicitly referring to the agent. We leave further exploration of this issue for future research, and provisionally encode the relevant argument of the main event as an agent.

The template hierarchy in (33) encodes the fact that the template TRAVERSAL calls the template TRANSITION, with the effect that TRAVERSAL incorporates all of the information in TRANSITION as well as specifying some additional information. The TRAVERSAL template is defined in (39):

(39) TRAVERSAL :=
 @TRANSITION
 $\lambda P \lambda e'. P(e') \wedge \text{traversal}(e') :$
 $[(\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap [(\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]$

The first line in the definition of TRAVERSAL contains the call to the template TRANSITION, marked as in (34) with the at sign '@'. The second line adds the information that e' is a traversal event. In technical terms, this meaning constructor behaves as a modifier on the predication associated with the transition event.

In turn, the TRAVERSAL-MEANS template is defined simply by calls to the TRAVERSAL template and the MEANS template:

$$(40) \quad \text{TRAVERSAL-MEANS} := \quad @\text{TRAVERSAL} \\ \quad \quad \quad @\text{MEANS}$$

The MEANS template is given in (41):

$$(41) \quad \text{MEANS} := \\ \lambda P \lambda e \lambda e'. P(e)(e') \wedge \text{means}(e') = e : \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]$$

The MEANS meaning constructor specifies that the event e represents the means of achieving the event e' . With respect to TRAVERSAL-MEANS, the main verb's event e is the means of achieving the event e' of traversing the path, as in an English example like *Sarah elbowed her way through the crowd* or the Swedish equivalent, where the traversal through the crowd is achieved by elbowing.

The SWEDISH-DMC template, specific to the Swedish Directed Motion Construction, is defined by reference to the template TRAVERSAL-MEANS. It also calls the syntactic subcategorization template TRANSITIVE-OBLIQUE, to be described in Section 4.2, and provides some additional material specific to the Swedish construction:

$$(42) \quad \text{SWEDISH-DMC(PFN)} := \\ @\text{TRANSITIVE-OBLIQUE(PFN)} \\ @\text{TRAVERSAL-MEANS} \\ \lambda Q \lambda P \lambda y. \exists e. \exists e'. \exists z. P(e)(e') \wedge \\ \text{theme}(e') = y \wedge \text{path}(e') = z \wedge Q(z) : \\ [((\uparrow \text{OBL})_{\sigma} \text{PATH}) \multimap (\uparrow \text{OBL})_{\sigma}] \multimap \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\ (\uparrow \text{OBJ})_{\sigma} \multimap \uparrow_{\sigma}$$

The argument of the SWEDISH-DMC template is called ‘PFN’ in this definition;¹² it is passed as an argument to the TRANSITIVE-OBLIQUE template, which is defined in (49). Besides the two template calls, SWEDISH-DMC also contributes a meaning constructor to complete the meaning of the Swedish construction, which requires the following:

¹²The template argument PFN is meant to be mnemonic for PRED FN, since this will ultimately play the role of FN in the value of a PRED feature.

- a meaning Q depending on the OBL phrase, specifying the nature of the path traversed; for (22) (\sim ‘Sarah elbowed her way through the crowd’), the path is required to go through the crowd;
- a meaning P , contributed by the main verb, specifying the nature of the event e denoted by the main verb and its relation to the transition event e' ; for (22) (\sim ‘Sarah elbowed her way through the crowd’), e is an elbowing event and is the means enabling the traversal event e' ;
- a meaning y for the object of the main verb, which is (syntactically) required to be a reflexive and hence to corefer with the subject of the main verb; y is the theme of e' , the traversal event.

Our analysis produces the meaning in (43) for *Sarah armbågade sig genom mängden* ‘Sarah elbowed SELF through the crowd’.

$$(43) \quad \exists e.\exists e'.\exists z.elbow(e) \wedge agent(e) = sarah \wedge cause(e') = sarah \wedge \\ means(e') = e \wedge traversal(e') \wedge theme(e') = sarah \wedge \\ path(e') = z \wedge through(z, ix.[crowd(x)])$$

A full proof of the derivation of this meaning is given in the Appendix.

4.2 Verb lexicon and basic subcategorization templates

Our approach entails a potentially deep consequence for the theory of argument linking and subcategorization, because verbs in our approach specify default subcategorization through template calls in such a way that the subcategorization can be constructionally overridden. Thus, subcategorization is moved to the template component.

We have seen that the SWEDISH-DMC template provides a PRED specification with subcategorization frame and semantic specifications for the construction. This in turn means that the lexical entry for a verb must supply a default PRED and semantics which can be overridden when the verb is used in a construction like the *way*-construction.¹³

¹³ Our analysis of the Swedish DMC and the English *way*-construction involves *replacing* rather than *modifying* the default semantic form of the main verb with the specifications provided by the construction. In the analysis of other constructions, it may be preferable to modify the semantic form via restriction (Kaplan and Wedekind, 1993; Asudeh, 2012) or other operators, as proposed for the analysis of complex predicates by Butt *et al.* (2003) (see also Butt and King 2005 on causatives).

We assume that the verb *elbowed/armbågade*, which appears in (16) and (22), is specified as follows:

$$(44) \quad \text{elbowed/armbågade} \quad V \\ \lambda e.\text{elbow}(e) : (\uparrow_{\sigma} \text{REL}) \\ \left(\begin{array}{l} @\text{TRANSITIVE}(\text{elbow}) \\ \lambda R \lambda x \lambda y \exists e. R(e) \wedge \text{agent}(e) = x \wedge \text{theme}(e) = y: \\ (\uparrow_{\sigma} \text{REL}) \multimap (\uparrow \text{SUBJ})_{\sigma} \multimap (\uparrow \text{OBJ})_{\sigma} \multimap \uparrow_{\sigma} \end{array} \right)$$

The first line of the entry specifies the verb’s semantic REL(ATION) in semantic structure, which it contributes on each occasion of its use. The second part of the entry specifies a default semantic contribution and subcategorization information, encoded by the template TRANSITIVE and the meaning constructor in the third line. This material effectively serves as a default, because unless some other part of the system specifies an alternative, constructional GF template, there is no way to check Completeness and Coherence and the structure fails.

The TRANSITIVE template takes a single argument, here ‘elbow’. The definition of TRANSITIVE is stated with respect to an arbitrary argument PFN:¹⁴

$$(45) \quad \text{TRANSITIVE}(\text{PFN}) := (\uparrow \text{PRED}) = \text{‘PFN}\langle(\uparrow \text{SUBJ}),(\uparrow \text{OBJ})\rangle\text{’}$$

The argument PFN of the TRANSITIVE template appears in parentheses after the template name, and also appears in the definition of the template as the FN of the semantic form that is the value of the PRED feature. For the verb *elbow*, the call to the TRANSITIVE template passes in the argument ‘elbow’. The template call @TRANSITIVE(*elbow*) is equivalent to the following equation:

$$(46) \quad (\uparrow \text{PRED}) = \text{‘elbow}\langle(\uparrow \text{SUBJ}),(\uparrow \text{OBJ})\rangle\text{’}$$

¹⁴ For ease of explication, (45) specifies an active subcategorization frame for the verb, simplifying away from mapping theory issues and the possibility for passivization of this verb. We return to a discussion of the interaction of mapping theory and our theory of constructions in Section 5 below, where we propose a revised TRANSITIVE template which refers to argument structure roles rather than grammatical functions and which interacts appropriately with mapping theory.

We now turn to the default meaning constructor for *elbowed* given in (44), repeated here:

$$(47) \quad \lambda R \lambda x \lambda y \exists e. R(e) \wedge \text{agent}(e) = x \wedge \text{theme}(e) = y: \\ (\uparrow_{\sigma} \text{REL}) \multimap (\uparrow \text{SUBJ})_{\sigma} \multimap (\uparrow \text{OBJ})_{\sigma} \multimap \uparrow_{\sigma}$$

This meaning constructor requires a REL R which is supplied by the verb (the REL for the verb *elbowed* is specified above as $\lambda e. \text{elbow}(e)$), a meaning x for the SUBJ, and a meaning y for the OBJ. For a sentence like *Bill elbowed Fred*, the meaning that is produced is, as desired:

$$(48) \quad \exists e. \text{elbow}(e) \wedge \text{agent}(e) = \text{Bill} \wedge \text{theme}(e) = \text{Fred}$$

When the verb *elbowed* is used in the traversal construction, these default specifications are overridden by the specifications imposed by the construction, and the special constructional specifications are used instead.

Three further subcategorization templates and one control template are used in the analysis below:

$$(49) \quad \text{TRANSITIVE-OBLIQUE(PFN)} := \\ (\uparrow \text{PRED}) = \text{'PFN}(\langle (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}), (\uparrow \text{OBL}) \rangle \text{'}$$

$$(50) \quad \text{TRANSITIVE-PREDICATIVE(PFN)} := \\ (\uparrow \text{PRED}) = \text{'PFN}(\langle (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}), (\uparrow \text{XCOMP}) \rangle \text{'}$$

$$(51) \quad \text{DITRANSITIVE-OBLIQUE(PFN)} := \\ (\uparrow \text{PRED}) = \text{'PFN}(\langle (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}), (\uparrow \text{OBJ}_{\theta}), (\uparrow \text{OBL}) \rangle \text{'}$$

$$(52) \quad \text{OBJ-CONTROL} := \quad (\uparrow \text{OBJ}) = (\uparrow \text{XCOMP SUBJ})$$

The TRANSITIVE-OBLIQUE template is called by the SWEDISH-DMC and ENGLISH-WAY templates, the TRANSITIVE-PREDICATIVE and OBJ-CONTROL templates are called by the DUTCH-TLC template, and the DITRANSITIVE-OBLIQUE template is called by the DUTCH-WEG template.

4.3

Lexically flagged constructions

The English *way*-construction relies on many of the same templates as the Swedish DMC. It is different in that it is completely regular in terms of phrasal structure, so no exceptional phrase structure rule is required. Rather, we assume the standard V' rule for English, which already permits an NP OBJECT and a PP OBLIQUE. Evidence that the PP is an argument of the main verb and not a modifier of *way* comes from adverb placement: it is possible for an adverb to intervene between *way* and the PP, while this is not possible if the PP is associated with the object:

(53) Sarah elbowed her way quickly through the crowd.

- (54) a. Sarah elbowed a friend from London quickly.
 b. *Sarah elbowed a friend quickly from London.

The locus of the English *way*-construction is the word *way*, which receives the following specification:

- (55) way N $(\uparrow \text{ PRED}) = \text{'way'}$
 $\lambda x.\text{way}(x) : (\uparrow_{\sigma} \text{ VAR}) \multimap (\uparrow_{\sigma} \text{ RESTR})$
 $(\text{ @ENGLISH-WAY}((\text{OBJ } \uparrow) \text{ PRED FN}))$

According to this lexical entry, *way* contributes a semantic form ‘way’ and a standard noun meaning $\lambda x.\text{way}(x)$ on every occasion of its use, even in the *way*-construction. As we will see, our analysis equates the path specified in the ENGLISH-WAY template with the path denoted by *way*. Retaining the standard semantics for *way* allows us to provide a satisfactory analysis of modification of *way* and specification of possessors of *way* other than the subject, as discussed in Section 2.1. The relevant examples are:

- (56) a. As ambassador, Chesterfield negotiated **Britain’s way** into the Treaty of Vienna in 1731.
 b. In these last twenty years Richard Strauss has flamed **his meteoric way** into our ken – and out of it.

The ENGLISH-WAY constructional template appears in parentheses, since it is an optional contribution of the word *way*. Its argument is $((\text{OBJ } \uparrow) \text{ PRED FN})$: this expression uses inside-out functional uncertainty to refer to the *f*-structure in which *way* is an OBJ, $(\text{OBJ } \uparrow)$, and passes the PRED FN of that *f*-structure as an argument to the template.

The definition of the ENGLISH-WAY template is:

$$\begin{aligned}
 (57) \quad \text{ENGLISH-WAY(PFN)} &:= \\
 &\quad @\text{TRANSITIVE-OBLIQUE(PFN)} \\
 &\quad \{ @\text{TRAVERSAL-MEANS} \mid @\text{TRAVERSAL-MANNER} \} \\
 &\quad \lambda Y \lambda Q \lambda P \lambda x. \exists e. \exists e'. \exists z. P(e)(e') \wedge \\
 &\quad \quad \text{theme}(e') = x \wedge \text{path}(e') = z \wedge \\
 &\quad \quad Q(z) \wedge z = Y(x) : \\
 &\quad [(\uparrow \text{SPEC})_\sigma \multimap \uparrow_\sigma] \multimap \\
 &\quad [(((\text{OBJ } \uparrow) \text{OBL})_\sigma \text{PATH}) \multimap ((\text{OBJ } \uparrow) \text{OBL})_\sigma] \multimap \\
 &\quad [((\text{OBJ } \uparrow)_\sigma \text{EVENT1}) \multimap \\
 &\quad \quad ((\text{OBJ } \uparrow)_\sigma \text{EVENT2}) \multimap (\text{OBJ } \uparrow)_\sigma] \multimap \\
 &\quad (\uparrow \text{SPEC})_\sigma \multimap (\text{OBJ } \uparrow)_\sigma
 \end{aligned}$$

As shown in the template hierarchy, (33), this definition calls the TRANSITIVE-OBLIQUE template and passes in the FN of the main verb, providing the semantic form and syntactic subcategorization specification for the construction. The second line contains a disjunction: either the TRAVERSAL-MEANS or the TRAVERSAL-MANNER template is called.¹⁵ This is because the English *way*-construction allows either a means interpretation for the construction or a manner interpretation. The TRAVERSAL-MANNER template is defined in (58) in terms of template calls to the TRAVERSAL and MANNER templates:

$$\begin{aligned}
 (58) \quad \text{TRAVERSAL-MANNER} &:= \quad @\text{TRAVERSAL} \\
 &\quad @\text{MANNER}
 \end{aligned}$$

The MANNER template, defined in (59), is similar to the MEANS template, defined in (41) above, in providing a meaning constructor that is a modifier (returning as its output the same type as its input). However, the MANNER specifies that a relation R is the manner by which the event e' is achieved, rather than stating that one event is the means of the other. The MANNER and MEANS templates thus have different types.

¹⁵ Some speakers do not find the manner interpretation well-formed. Our analysis accounts for their grammars through lexical variation: the ENGLISH-WAY template in the grammars of these speakers calls only the TRAVERSAL-MEANS template.

$$\begin{aligned}
 (59) \quad \text{MANNER} &:= \\
 &\lambda \mathcal{P} \lambda R \lambda e'. \mathcal{P}(R)(e') \wedge \text{manner}(e') = R : \\
 &[(\uparrow_{\sigma} \text{REL}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\
 &[(\uparrow_{\sigma} \text{REL}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]
 \end{aligned}$$

Besides the template calls in the first two lines, the ENGLISH-WAY template contributes the following meaning constructor:

$$\begin{aligned}
 (60) \quad &\lambda Y \lambda Q \lambda P \lambda x. \exists e. \exists e'. \exists z. P(e)(e') \wedge \\
 &\text{theme}(e') = x \wedge \text{path}(e') = z \wedge \\
 &Q(z) \wedge z = Y(x) : \\
 &[(\uparrow \text{SPEC})_{\sigma} \multimap \uparrow_{\sigma}] \multimap \\
 &[(((\text{OBJ } \uparrow) \text{OBL})_{\sigma} \text{PATH}) \multimap ((\text{OBJ } \uparrow) \text{OBL})_{\sigma}] \multimap \\
 &[(\text{OBJ } \uparrow)_{\sigma} \text{EVENT1}] \multimap \\
 &((\text{OBJ } \uparrow)_{\sigma} \text{EVENT2}) \multimap (\text{OBJ } \uparrow)_{\sigma}] \multimap \\
 &(\uparrow \text{SPEC})_{\sigma} \multimap (\text{OBJ } \uparrow)_{\sigma}
 \end{aligned}$$

This meaning constructor requires:

- a meaning Y for the way NP, which provides additional information about the path z that is traversed;
- a meaning Q for the oblique phrase; for example (22), *Sarah elbowed her way through the crowd*, this is the meaning of *through the crowd*, which characterizes the path z ;
- a meaning P , contributed by the main verb, specifying the nature of the event e and its relation to the traversal event; for *Sarah elbowed her way through the crowd*, e is required to be an elbowing event and is the means enabling the traversal event;
- a meaning x for the possessor of way, which plays the role of the theme of the traversal event e' .¹⁶

¹⁶ As mentioned in footnote 4, the way-phrase may be an indefinite:

- (i) Daimler bought a way into the Chinese market and then removed Chrysler from it.
www.thetruthaboutcars.com/2013/04/jeep-eyeing-chinese-cherokee-production/ (retrieved May 28, 2013)

The analysis in the body of the paper does not currently capture indefinite cases, but it could be augmented by providing, in the ENGLISH-WAY template, an optional existential closure over the term $(\uparrow \text{SPEC})_{\sigma}$; this would be simi-

This analysis produces the meaning in (61) for the means interpretation of *Sarah elbowed her way through the crowd*:

$$(61) \quad \exists e. \exists e'. \exists z. \text{elbow}(e) \wedge \text{agent}(e) = \text{sarah} \wedge \text{cause}(e') = \text{sarah} \wedge \\ \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = \text{sarah} \wedge \\ \text{path}(e') = z \wedge \text{through}(z, \iota x. [\text{crowd}(x)]) \wedge \\ z = \iota y. [\text{way}(y) \wedge R_c(\text{sarah}, y)]$$

The main difference between this meaning and the meaning of its Swedish counterpart *Sarah armbågade sig genom mängden* is that the English way-construction provides a more detailed specification of the path z . We follow Partee (1983/1997) and Partee and Borschev (1998) in treating the genitive construction as involving reference to a unique individual who bears some contextually specified relation R_c to a possessor. The possessive pronoun in the phrase *her way* is resolved to the subject *Sarah*, and the meaning of *her way* is analyzed as $\iota y. [\text{way}(y) \wedge R_c(\text{sarah}, y)]$, the unique y that is a way and that bears the relation R_c to Sarah. This analysis enables us to treat cases in which *way* is modified or possessed by an individual other than the subject of the construction. Full proofs for *Sarah elbowed her way through the crowd* and *Chesterfield negotiated Britain's way into the Treaty of Vienna* are given in the Appendix.

lar to how optional objects of semantically transitive verbs like *eat* are handled in the analysis of Asudeh and Giorgolo (2012). The relevant first conjunct of example (i) would then have the meaning $\exists x'. \exists e. \exists e'. \exists z. \text{buy}(e) \wedge \text{agent}(e) = \text{daimler} \wedge \text{cause}(e') = \text{daimler} \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = x' \wedge \text{path}(e') = z \wedge \text{into}(z, \iota x. [\text{chinese-market}(x)]) \wedge z = \exists y. [\text{way}(y) \wedge R_c(x', y)]$. In sum, the example would be interpreted such that Daimler bought *someone's* way into the Chinese market (where the path traversal is interpreted metaphorically). The fact that this is likely to have been Daimler's own way is a matter of a further, bridging-like pragmatic inference (Haviland and Clark, 1974).

4.4

Traversal constructions in Dutch

The templates for the Dutch *weg*-construction and the Transition to Location Construction are as follows:

$$\begin{aligned}
 (62) \quad \text{DUTCH-WEG(PFN)} &:= \\
 &\text{@DITRANSITIVE-OBLIQUE(PFN)} \\
 &\{\text{@TRAVERSAL-MEANS} \mid \text{@TRAVERSAL-MANNER}\} \\
 &\lambda Y \lambda Q \lambda P \lambda y \lambda x. \exists e. \exists e'. \exists z. P(e)(e') \wedge \\
 &\quad \text{theme}(e') = y \wedge \text{path}(e') = z \wedge \\
 &\quad Q(z) \wedge z = Y(x) \wedge \text{coextensive}(e, e') : \\
 &[(\uparrow \text{SPEC})_\sigma \multimap \uparrow_\sigma] \multimap \\
 &[\text{(((OBJ}_\theta \uparrow) \text{OBL})}_\sigma \text{PATH}) \multimap ((\text{OBJ}_\theta \uparrow) \text{OBL})_\sigma] \multimap \\
 &[(\text{OBJ}_\theta \uparrow)_\sigma \text{EVENT1}] \multimap \\
 &((\text{OBJ}_\theta \uparrow)_\sigma \text{EVENT2}) \multimap (\text{OBJ}_\theta \uparrow)_\sigma] \multimap \\
 &(\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{SPEC})_\sigma \multimap (\text{OBJ}_\theta \uparrow)_\sigma
 \end{aligned}$$

DUTCH-WEG, like the English *way*-construction, allows either a means or manner interpretation and further specifies that the events denoted by the main verb and the traversal event are coextensive.

$$\begin{aligned}
 (63) \quad \text{DUTCH-TLC(PFN)} &:= \\
 &\text{@TRANSITIVE-PREDICATIVE(PFN)} \\
 &\text{@OBJ-CONTROL} \\
 &\text{@TRANSITION} \\
 &\text{@MEANS} \\
 &\lambda Q \lambda P \lambda x. \exists e. \exists e'. P(e)(e') \wedge \text{theme}(e') = x \wedge Q(x) : \\
 &[(\uparrow \text{OBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma] \multimap \\
 &[(\uparrow_\sigma \text{EVENT1}) \multimap (\uparrow_\sigma \text{EVENT2}) \multimap \uparrow_\sigma] \multimap \\
 &(\uparrow \text{OBJ})_\sigma \multimap \uparrow_\sigma
 \end{aligned}$$

DUTCH-TLC involves a transition but not necessarily a traversal, and so is defined in terms of the TRANSITION template. It specifies a means interpretation (and disallows a manner interpretation), and so incorporates the MEANS template in its definition. We assume that the prepositional phrase serves as a secondary predication on the object, since van Egmond (2006, 2009) argues that there is no path traversal in this case and also notes that the TLC bears some similarities to the resultative. In LFG-theoretic terms, this indicates that the PP is an XCOMP, which is why there is a call to OBJ-CONTROL.

LINKING

We now return to the definition of syntactic subcategorization requirements in the templates that appear as defaults in verbal lexical entries and as specifications of subcategorization requirements in the *way*- and DMC constructions. Recall that for simplicity, we assumed that the relation between semantic roles and grammatical functions is fixed by the construction or by information in the lexical entry of a predicate. For example, the default subcategorization for a verb like *elbowed/armbågade* was given by the TRANSITIVE template, defined above as:

$$(45) \quad \text{TRANSITIVE(PFN)} := (\uparrow \text{PRED}) = \text{'PFN}(\langle (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}) \rangle \text{'}$$

This is overly inflexible; the correct analysis would specify argument structure information for the predicate or construction rather than a specific set of grammatical functions, and would appeal to some version of Mapping Theory (Bresnan and Zaenen, 1990; Alsina, 1993; Butt, 1995; Butt *et al.*, 1997) to derive the syntactic subcategorization frame for the predicate from argument structure. We sketch here how this would work for the lexical specifications for the verb *elbow*, following the approach of Butt *et al.* (1997).

Butt *et al.* (1997) assume the following projection architecture:

$$(64) \quad \begin{array}{c} \text{V} \\ | \\ \text{elbow} \end{array} \xrightarrow{\alpha} \left[\begin{array}{cc} \text{REL} & \text{ELBOW} \\ \text{AGENT} & [] \\ \text{THEME} & [] \end{array} \right] \begin{array}{l} \xrightarrow{\lambda} f1;[] \xrightarrow{\sigma} s1;[] \\ \xrightarrow{\lambda} f2;[] \xrightarrow{\sigma} s2;[] \end{array}$$

Argument structure is represented as an attribute-value matrix reachable from the c-structure via the α projection. The familiar ϕ projection is defined as the composition of the α projection to argument structure and the λ projection from argument structure to f-structure.

The lexical entry for *elbowed/armbågade* can now be stated as:¹⁷

¹⁷ The variable $\hat{*}$ refers to the mother of the c-structure node that bears the annotation. Thus, $\hat{*}_\alpha$ in the lexical entry refers to the argument structure of the mother of the terminal node *elbowed/armbågade*, i.e. the argument structure of V.

- (65) *elbowed/armbågade* V
 $\lambda e.elbow(e) : (\uparrow_\sigma \text{REL})$

$$\left(\begin{array}{l} (\uparrow \text{PRED FN}) = \text{elbow} \\ \lambda R \lambda x \lambda y \lambda e. R(e) \wedge \text{agent}(e) = x \wedge \text{theme}(e) = y : \\ (\uparrow_\sigma \text{REL}) \multimap (\widehat{*}_\alpha \text{AGENT})_{\lambda\sigma} \multimap \\ (\widehat{*}_\alpha \text{THEME})_{\lambda\sigma} \multimap (\uparrow_\sigma \text{EVENT}) \multimap \uparrow_\sigma \end{array} \right)$$

Instead of specifying the default grammatical functions SUBJ and OBJ, this lexical entry specifies a default argument structure containing an AGENT and a THEME. These will be linked to the appropriate grammatical functions according to mapping theory.¹⁸

The English *way*-construction and the Swedish DMC construction could be treated similarly, with argument structure roles specified in the templates for the construction, and the mapping from argument structure roles to grammatical functions provided by mapping theory. However, these constructions do in fact seem to be syntactically inflexible, and cannot undergo passivization or other argument alternations:¹⁹

- (66) *Bill's way through the park was *elbowed* (by him).

- (67) *Bill *armbågade* genom parken (av sig/sig själv).

Bill *elbow.PASS* through park.DEF by SELF/himself

Given this, we propose to leave the templates appearing in those constructions in their current form, since we believe that specifying particular grammatical functions and disallowing argument alternations such as passive is the right treatment for these.

6

CONCLUSION

We have shown that it is not necessary to eliminate the word/phrase or lexicon/grammar distinctions in order to capture constructional effects in a principled manner. We did so by showing how this could be done in the context of Lexical-Functional Grammar, which upholds the Strong Lexicalist Hypothesis through the Lexical Integrity Princi-

¹⁸See Asudeh and Giorgolo (2012) for an alternative representation of argument structure.

¹⁹The judgement for the Swedish example is for the DMC interpretation; see Toivonen (2002) for further discussion.

ple. Like other LFG work, our approach retains Lexical Integrity as a foundational principle, due to the multifaceted nature of grammatical representation in LFG: the same functional structure and semantics can be associated with a part of a word, a word, or a phrase, but this does not imply that words and phrases are indistinguishable at other levels. We can capture the fundamental differences between words and phrases that motivate Lexical Integrity at the level of constituent structure, while also capturing commonalities in the abstract syntactic and semantic contributions of words and phrases.

Our approach captures the intuitions of Construction Grammar in an LFG setting by the use of templates, which allow for generalizations to be expressed by naming and reusing grammatical descriptions. We accomplish this without in any sense admitting constructions as first-class entities in the theory: the ability to name and reuse descriptions adds no new formal power or new formal objects to the theory. Though templates were independently motivated in much previous work for reasons of expediency in grammar writing, they now play a crucial theoretical role: templates serve as the locus of grammatical information that can be either lexically or structurally invoked, and they thus formalize one aspect of the lexicon–syntax interface. The templates are nevertheless just abbreviations for grammatical descriptions: a grammar with templates is extensionally equivalent to the same grammar with all template calls replaced by the corresponding template content. According to this view, then, in an important sense constructions are epiphenomenal.

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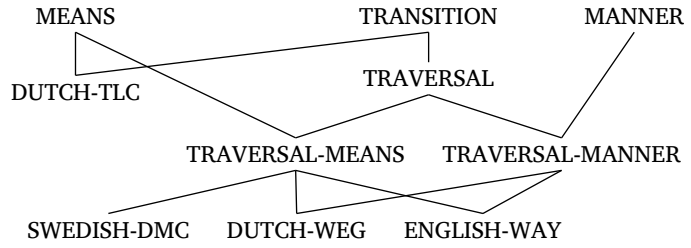
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APPENDIX

A

TEMPLATE HIERARCHY

(68)



B

TEMPLATES

(69) TRANSITION :=

$$\lambda R \lambda x \lambda e \lambda e'. R(e) \wedge \text{agent}(e) = x \wedge \text{cause}(e') = x : \\ (\uparrow_{\sigma} \text{REL}) \multimap (\uparrow \text{SUBJ})_{\sigma} \multimap (\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}$$

(70) MEANS :=

$$\lambda P \lambda e \lambda e'. P(e)(e') \wedge \text{means}(e') = e : \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]$$

(71) MANNER :=

$$\lambda \mathcal{P} \lambda R \lambda e'. \mathcal{P}(R)(e') \wedge \text{manner}(e') = R : \\ [(\uparrow_{\sigma} \text{REL}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\ [(\uparrow_{\sigma} \text{REL}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]$$

(72) TRAVERSAL :=

$$\text{@TRANSITION} \\ \lambda P \lambda e'. P(e') \wedge \text{traversal}(e') : \\ [(\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap [(\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}]$$

(73) TRAVERSAL-MEANS := @TRAVERSAL
@MEANS

(74) TRAVERSAL-MANNER := @TRAVERSAL
@MANNER

(75) SWEDISH-DMC(PFN) :=

$$\text{@TRANSITIVE-OBLIQUE(PFN)} \\ \text{@TRAVERSAL-MEANS} \\ \lambda Q \lambda P \lambda y. \exists e. \exists e'. \exists z. P(e)(e') \wedge \\ \text{theme}(e') = y \wedge \text{path}(e') = z \wedge Q(z) : \\ [(\uparrow \text{OBL})_{\sigma} \text{PATH}) \multimap (\uparrow \text{OBL})_{\sigma}] \multimap \\ [(\uparrow_{\sigma} \text{EVENT1}) \multimap (\uparrow_{\sigma} \text{EVENT2}) \multimap \uparrow_{\sigma}] \multimap \\ (\uparrow \text{OBJ})_{\sigma} \multimap \uparrow_{\sigma}$$

- (76) ENGLISH-WAY(PFN) :=
 @TRANSITIVE-OBLIQUE(PFN)
 {@TRAVERSAL-MEANS | @TRAVERSAL-MANNER}
 $\lambda Y \lambda Q \lambda P \lambda x. \exists e. \exists e'. \exists z. P(e)(e') \wedge$
 $theme(e') = x \wedge path(e') = z \wedge$
 $Q(z) \wedge z = Y(x) :$
 $[(\uparrow SPEC)_\sigma \multimap \uparrow_\sigma] \multimap$
 $[(((OBJ \uparrow) OBL)_\sigma PATH) \multimap ((OBJ \uparrow) OBL)_\sigma] \multimap$
 $[((OBJ \uparrow)_\sigma EVENT1) \multimap$
 $((OBJ \uparrow)_\sigma EVENT2) \multimap (OBJ \uparrow)_\sigma] \multimap$
 $(\uparrow SPEC)_\sigma \multimap (OBJ \uparrow)_\sigma$
- (77) DUTCH-WEG(PFN) :=
 @DITRANSITIVE-OBLIQUE(PFN)
 {@TRAVERSAL-MEANS | @TRAVERSAL-MANNER}
 $\lambda Y \lambda Q \lambda P \lambda y \lambda x. \exists e. \exists e'. \exists z. P(e)(e') \wedge$
 $theme(e') = y \wedge path(e') = z \wedge$
 $Q(z) \wedge z = Y(x) \wedge coextensive(e, e') :$
 $[(\uparrow SPEC)_\sigma \multimap \uparrow_\sigma] \multimap$
 $[(((OBJ_\theta \uparrow) OBL)_\sigma PATH) \multimap ((OBJ_\theta \uparrow) OBL)_\sigma] \multimap$
 $[((OBJ_\theta \uparrow)_\sigma EVENT1) \multimap$
 $((OBJ_\theta \uparrow)_\sigma EVENT2) \multimap (OBJ_\theta \uparrow)_\sigma] \multimap$
 $(\uparrow OBJ)_\sigma \multimap (\uparrow SPEC)_\sigma \multimap (OBJ_\theta \uparrow)_\sigma$
- (78) DUTCH-TLC(PFN) :=
 @TRANSITIVE-PREDICATIVE(PFN)
 @OBJ-CONTROL
 @TRANSITION
 @MEANS
 $\lambda Q \lambda P \lambda x. \exists e. \exists e'. P(e)(e') \wedge theme(e') = x \wedge Q(x) :$
 $[(\uparrow OBJ)_\sigma \multimap (\uparrow XCOMP)_\sigma] \multimap$
 $[(\uparrow_\sigma EVENT1) \multimap (\uparrow_\sigma EVENT2) \multimap \uparrow_\sigma] \multimap$
 $(\uparrow OBJ)_\sigma \multimap \uparrow_\sigma$

C

EXAMPLES

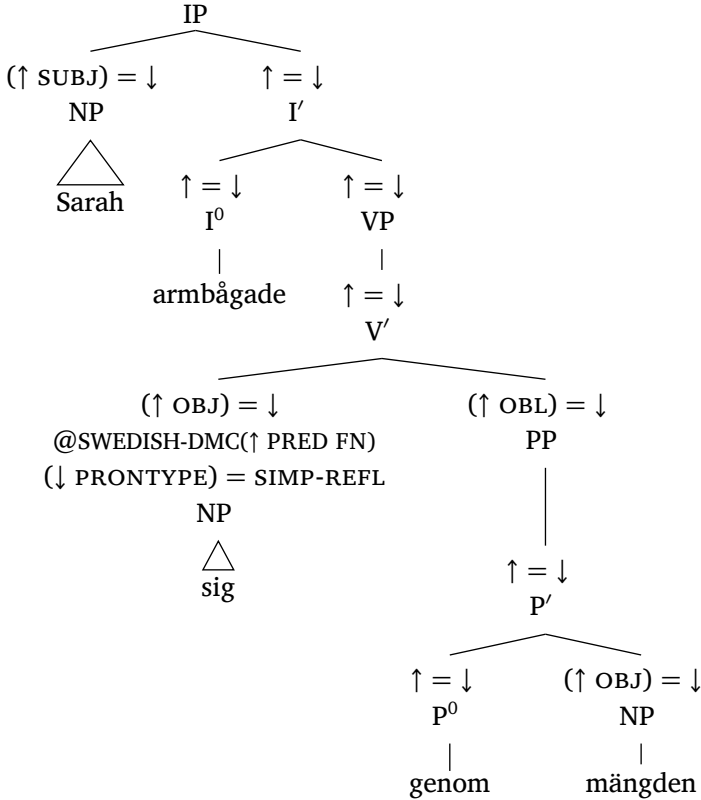
C.1

Swedish

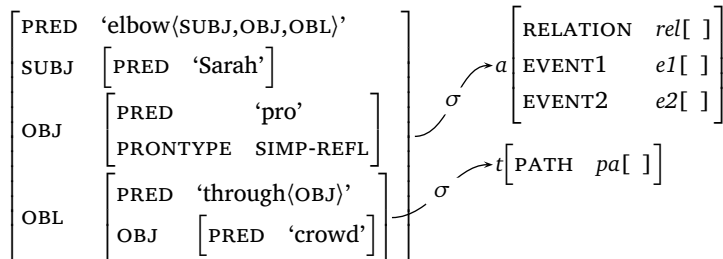
(79) Sarah armbågade sig genom mängden.

S. elbowed SELF through crowd.DEF

(80)



(81)

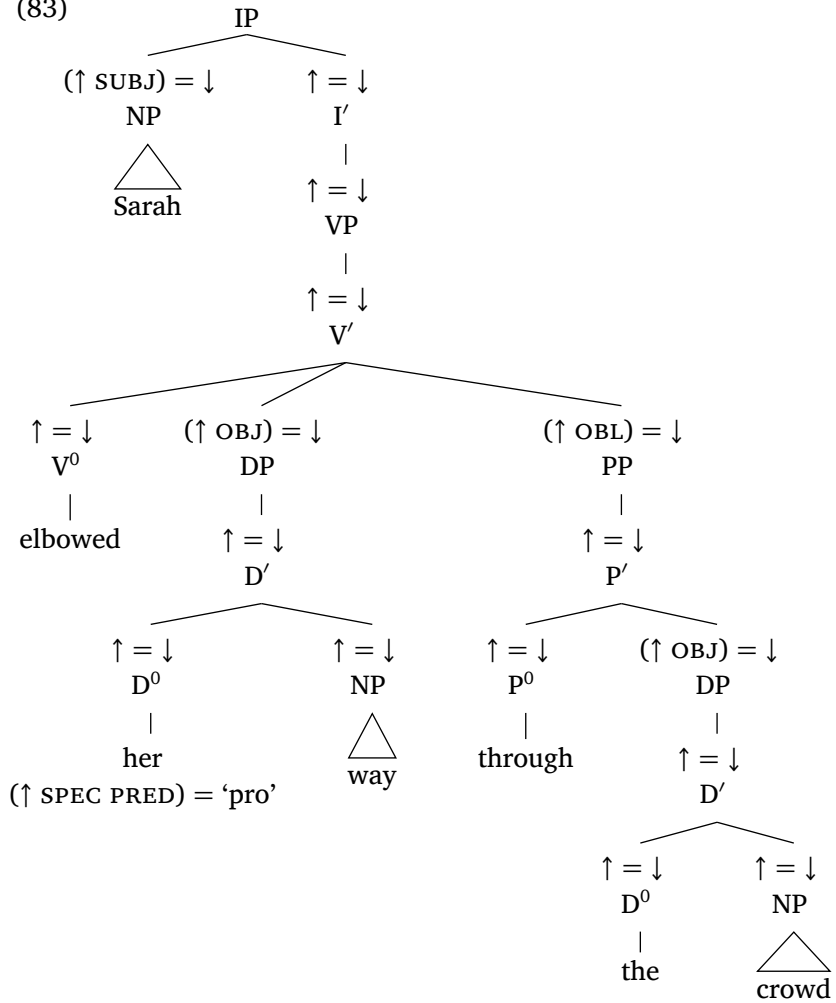


C.2

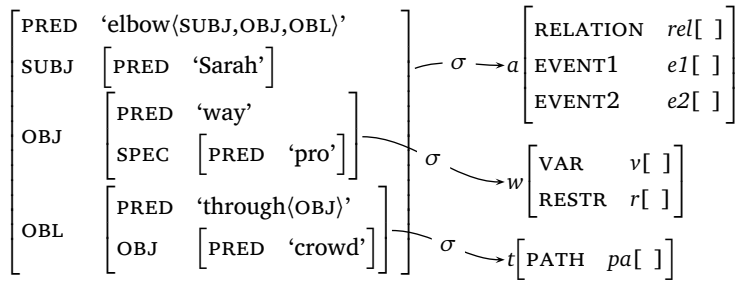
English

(82) Sarah elbowed her way through the crowd.

(83)



(84)



3.

Figure 1: Glue Semantics proof for (79); Swedish Directed Motion Construction

TRANSITION	
elbowed	$\lambda R \lambda x \lambda e \lambda e'. R(e) \wedge$
$\lambda e \lambda \text{elbow}(e) :$	$\text{agent}(e) = x \wedge$
rel	$\text{cause}(e') = x :$
	$\text{rel} \rightarrow s \rightarrow e1 \rightarrow e2 \rightarrow a$
	$\lambda x \lambda e \lambda e' \lambda \text{elbow}(e) \wedge$
	$\text{agent}(e) = x \wedge$
	$\text{cause}(e') = x :$
	$s \rightarrow e1 \rightarrow e2 \rightarrow a$
MEANS	
$[y_1 : s]^1$	$\lambda P \lambda e \lambda e' P(e)(e') \wedge$
$\lambda e \lambda e' \lambda \text{elbow}(e) \wedge$	$\text{means}(e') = e :$
$\text{agent}(e) = y_1 \wedge \text{cause}(e') = y_1 :$	$(e1 \rightarrow e2 \rightarrow a) \rightarrow$
$e1 \rightarrow e2 \rightarrow a$	$(e1 \rightarrow e2 \rightarrow a)$
	$\lambda e \lambda e' \lambda \text{elbow}(e) \wedge \text{agent}(e) = y_1 \wedge$
	$\text{cause}(e') = y_1 \wedge \text{means}(e') = e :$
	$e1 \rightarrow e2 \rightarrow a$
$[e'' : e1]^3$	TRAVERSAL
	$\lambda P \lambda e' P(e') \wedge \text{traversal}(e') :$
	$(e2 \rightarrow a) \rightarrow (e2 \rightarrow a)$
	$\lambda e' \lambda \text{elbow}(e'') \wedge \text{agent}(e'') = y_1 \wedge$
	$\text{cause}(e') = y_1 \wedge \text{means}(e') = e'' :$
	$e1 \rightarrow e2 \rightarrow a$
	$\lambda e'' \lambda e' \lambda \text{elbow}(e'') \wedge \text{agent}(e'') = y_1 \wedge$
	$\text{cause}(e') = y_1 \wedge \text{means}(e') = e'' :$
	$e1 \rightarrow e2 \rightarrow a$
	$\lambda x \cdot \exists e \cdot \exists e' \cdot \exists z \lambda \text{elbow}(e) \wedge \text{agent}(e) = y_1 \wedge$
	$\text{cause}(e') = y_1 \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = x \wedge$
	$\text{path}(e') = z \wedge \text{through}(z, x, x[\text{crowd}(x)]) \wedge z = y_1[\text{way}(y) \wedge R(x, y)] :$
	$p \rightarrow a$
Sarah	her₁
$\text{sarah} :$	$\lambda x y x y :$
s	$s \rightarrow s \otimes p$
$\text{sarah} \times \text{sarah} : s \otimes p$	$\exists e \cdot \exists e' \cdot \exists z \lambda \text{elbow}(e) \wedge \text{agent}(e) = y_1 \wedge$
	$\text{cause}(e') = y_1 \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = x_1 \wedge$
	$\text{path}(e') = z \wedge \text{through}(z, x, x[\text{crowd}(x)]) \wedge z = y_1[\text{way}(y) \wedge R(x, y)] : a$
	$\otimes_{e1,2}$
	$\exists e \cdot \exists e' \cdot \exists z \lambda \text{elbow}(e) \wedge \text{agent}(e) = \text{sarah} \wedge$
	$\text{cause}(e') = \text{sarah} \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = \text{sarah} \wedge$
	$\text{path}(e') = z \wedge \text{through}(z, x, x[\text{crowd}(x)]) \wedge z = y_1[\text{way}(y) \wedge R(\text{sarah}, y)] : a$

Figure 2: Glue Semantics proof for (82); English Way Construction (means interpretation)

[illegible]

Figure 3: Glue Semantics proof for (82); English Way Construction (manner interpretation)

TRANSITION	
negotiated $\lambda x.\lambda y.\lambda e'.R(e) \wedge$ $\text{agent}(e) = x \wedge$ $\text{cause}(e') = x :$ $r \text{ el} \rightarrow c \rightarrow e1 \rightarrow e2 \rightarrow n$	
Chesterfield $\text{chesterfield} :$ c	$\lambda x.\lambda y.\lambda e'.\text{negotiate}(e) \wedge$ $\text{agent}(e) = x \wedge$ $\text{cause}(e') = x :$ $c \rightarrow e1 \rightarrow e2 \rightarrow n$
MEANS	
$\lambda x.\lambda e'.\text{negotiate}(e) \wedge$ $\text{agent}(e) = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} :$ $e1 \rightarrow e2 \rightarrow n$	$\lambda P.\lambda x.\lambda e'.P(e) \wedge$ $\text{means}(e') = e :$ $(e1 \rightarrow e2 \rightarrow n) \rightarrow$ $(e1 \rightarrow e2 \rightarrow n)$
$\lambda x.\lambda e'.\text{negotiate}(e) \wedge \text{agent}(e) = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} \wedge \text{means}(e') = e :$ $e1 \rightarrow e2 \rightarrow n$	ENGLISH-WAY $\lambda Y.\lambda Q.\lambda P.\lambda x.\exists e'.\exists x'.P(e)(e') \wedge$ $\text{theme}(e') = x \wedge \text{path}(e') = z \wedge$ $Q(e) \wedge z = Y(x) :$ $(b \rightarrow w) \rightarrow (pa \rightarrow i) \rightarrow$ $(e1 \rightarrow e2 \rightarrow n) \rightarrow b \rightarrow n$
$\lambda e'.\text{negotiate}(e') \wedge \text{agent}(e') = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} \wedge$ $\text{means}(e') = e' : e2 \rightarrow n$	TRAVERSAL $\lambda P.\lambda e'.R(e') \wedge \text{traversal}(e') :$ $(e2 \rightarrow n) \rightarrow (e2 \rightarrow n)$
$\lambda e'.\text{negotiate}(e') \wedge \text{agent}(e') = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} \wedge$ $\text{means}(e') = e' : e2 \rightarrow n$	$\lambda Q.\lambda P.\lambda x.\exists e'.\exists x'.P(e)(e') \wedge \text{theme}(e') = x \wedge$ $\text{path}(e') = z \wedge Q(e) \wedge z = y : [way(y) \wedge R(x,y)] :$ $(pa \rightarrow i) \rightarrow (e1 \rightarrow e2 \rightarrow n) \rightarrow b \rightarrow n$
Britain $\text{britain} :$ b	$\lambda x.\exists e'.\exists x'.\exists x''.\text{negotiate}(e) \wedge \text{agent}(e) = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = x \wedge$ $\text{path}(e') = z \wedge \text{intro}(e, t \rightarrow y) \wedge z = y : [way(y) \wedge R(x,y)] :$ $b \rightarrow n$
	$\exists x.\exists x'.\exists x''.\text{negotiate}(e) \wedge \text{agent}(e) = \text{chesterfield} \wedge$ $\text{cause}(e') = \text{chesterfield} \wedge \text{means}(e') = e \wedge \text{traversal}(e') \wedge \text{theme}(e') = e$ $\text{path}(e') = z \wedge \text{intro}(e, t \rightarrow y) \wedge z = y : [way(y) \wedge R(\text{britain}, y)] : n$
	$\lambda x.\lambda y.\lambda e'.\exists x'.\exists x''.\text{negotiate}(e) \wedge \text{agent}(e) = x \wedge$ $\text{path}(e') = z \wedge \text{intro}(z, t \rightarrow y) \wedge z = y : [way(y) \wedge R(x,y)] :$ $(e1 \rightarrow e2 \rightarrow n) \rightarrow b \rightarrow n$
	way $\lambda x.\lambda y.\lambda e'.P(y) \wedge R(x,y) :$ $(v \rightarrow r) \rightarrow w$ $y \rightarrow r$
	$[z : b]^2$ $\lambda x.\lambda y.\lambda e'.P(y) \wedge R(x,y) :$ $(v \rightarrow r) \rightarrow w$ $y : [way(y) \wedge R(x,y)] : w$ $\lambda x.\lambda y : [way(y) \wedge R(x,y)] : b \rightarrow w$ $t \rightarrow pa \rightarrow i$ $\lambda y : \text{intro}(y, t \rightarrow y) : pa \rightarrow i$
	into $\lambda x.\lambda y.\text{intro}(y, z) :$ $t \rightarrow pa \rightarrow i$
	the Treaty of Vienna $t \rightarrow w :$ t

Figure 4: Glue Semantics proof for *Chesterfield negotiated Britain's way into the Treaty of Vienna*; English Way Construction (means interpretation)

Ash Asudeh et al.

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